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CENTRAL INTELLIGENCE AGENCY

REPORT

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SUBJECT Basic Concepts and Procedure for Calculation of Stability (Unsinkability) of Vessels

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1. All sea-going vessels in the USSR have some degree of damage stability depending on the purpose of the ship. Special importance is attached to damage stability in combat vessels. However, account is taken of the fact that any great increase in the number of watertight bulkheads is not practical, since the destruction radius of a torpedo or mine is sometimes as high as eight meters. Also frequently the spacing of water-tight bulkheads greatly complicates distribution of machinery with no added benefit and increased hull weight.

2. In addition, dividing the ship into compartments by lengthwise bulkheads gives rise to great angles of pitch when these compartments are flooded.

3. Consequently, damage stability of ships is achieved by the rational distribution of a minimum number of transverse bulkheads while providing for an adequate amount of buoyancy.

4. Pumping facilities are not capable of handling water as fast as it comes through a torpedo or mine hole, but can only empty a compartment after the hole has been sealed.

5. The study of damage stability consists of resolving the following problems:
   (a) Determination of stability and position in the water after one or several compartments have been flooded.
   (b) Rational distribution of transverse bulkheads, taking into account possible changes in stability and position in the water.

6. In determining position in the water and stability, three basic types of flooding are considered:
   (a) Whether the compartment is closed from the top and water has filled it completely
   (b) Whether the compartment is open at the top, and partially filled with water

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which is not in contact with water outside the ship.

(c) Whether compartment is open at the top and contains water which is in contact with water outside the ship; the volume of water changes according to the level of the water line.

7. The so-called coefficients of penetration or flooding are taken into account in computations. These coefficients are a fraction of one and are arrived at according to the purpose of the compartment. These coefficients are used in order to allow for the fact that the volume of water flowing into a compartment will always be less than determined on the theoretical blue prints of the ship since the compartments are always filled to the same extent with equipment, machinery and cargo.

Procedure for Calculating Maximum Length of Compartments. Distribution of Transverse Watertight Compartments

8. The problem of rational distribution of transverse watertight compartments for USSR merchant vessels is resolved in accordance with requirements of safe sailing. There is no requirement for damage stability (unsinkability) when any single compartment is flooded on cargo ships. The minimum number of transverse watertight compartments is established by rules of the USSR Sea Registry. According to these rules, the first forward watertight bulkhead must be built at a distance of not more than 5% of the length of the vessel from the leading edge of the bow, based on the summer cargo waterline.

9. The after watertight bulkhead for one-screw vessels must be placed at such distance from the sternpost that the entire deadwood funnel be contained in this compartment. This requirement is based on assuring damage stability (unsinkability) only when the end compartments are flooded.

10. In addition to the end watertight bulkheads, the USSR Sea Registry requires for cargo vessels two watertight bulkheads separating the machine-boiler room if it is located midships.

11. In addition to the indicated four bulkheads, additional watertight bulkheads are set up; the number of these depends on the length of the vessel as follows:

Vessel Length in meters	Additional Bulkheads		Total number of bulkheads
	Number	Place where built	
From 87 to 102	1	approximately in the middle between the bow bulkhead and the machine-boiler room	5
from 102 to 124	2	one in the forward section, the second in the stern section	6
from 124 to 145	3	- - -	7
from 145 to 165	4	- - -	8
from 165 to 186	5	- - -	9

12. When the machine-boiler room division is located aft, one watertight bulkhead is built which separates this section from the bow of the ship and in this way damage stability when the machine-boiler section is flooded is assured.

13. When the vessel is up to 87 meters in length and the machine-boiler section is located aft, one additional bulkhead is built about in the middle between the bow bulkhead and the machine-boiler section bulkhead.

14. When the ship is longer than 87 meters, the location of the bulkheads is established by the USSR Sea Registry individually for each case (this is in the case of ships whose machine-boiler room section is in the after part of the ship).

15. In cargo-passenger and passenger ships the transverse watertight bulkheads are located in such a way as to assure damage stability no matter which compartment is flooded. In order to solve this problem, a deck has been built to which all watertight bulkheads extend. This deck in damage stability calculations is called the bulkhead deck. At a distance of 76 millimeters below this deck and parallel to it there is a line which is called the maximum submersion line. Then the compartment length limit is established at any point along the length of the vessel. This is the length limit compartment which, when flooded, will make the vessel sink to the limit depth of submersion. In order to determine the length limits of compartments, calaculations are made, from the results of which the curve of length limit of flooding is constructed. The ordinates of this curve represent the length limits of flooded compartments for various points along the length of the vessel. The initial data for constructing this curve are selected from the Bonjean scale.

16. In designing passenger and cargo-passenger vessels, tranverse watertight bulkheads are laid out not according to the length limit of compartments but according to the so-called permissible length of compartments. The figure for the permissible length of compartments is arrived at by multiplying the calculated length limit of compartments by a multiplier called the safety coefficient the magnitude of which fluctuates between 1/3-1, and is determined according to the type and size of the vessel.

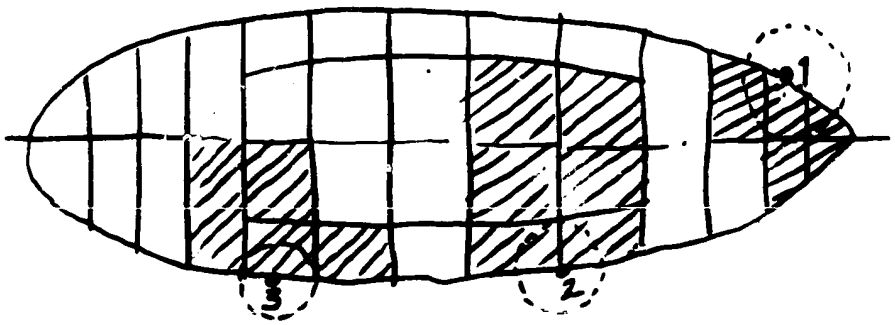
17. The actual and permissible length of compartments is set up for comparison on the curve of the permissible length of compartments. Damage stability is considered assured if the actual length of compartments is less than or equal to the permissible length.

18. According to rules of the USSR Sea Registry, a test must be made of vessel stability under conditions of the most unfavorable possible case of compartment flooding.

19. In studying the problem of damage stability of fighting vessels, it must first be noted that there are a great number of watertight bulkheads. These bulkheads are set up taking into account the general location of machine-boiler installations, weapons, powder magazines, auxiliary equipment, office and bunk space, etc.

20. After the transverse watertight bulkheads have been set up, the damage stability computations are made. Based on the destruction radius of a modern mine or torpedo, the most serious incidents of compartments flooding (indicated on the sketch) are determined For such incidents of flooding the mean settling of the vessel, the angle of static list the angle of trim, settling of bow, settling of stern, minimum height of freeboard and transvere stability are determined. If the results of computations are unfavorable, the bulkheads are redistributed in order to assure damage stability.

21. When the vessel has fore-and-aft bulkheads, the possible incidents of flooding are made to include asymmetrical compartments flooding as well as symmetrical.



The numbers 1, 2 and 3 indicate possible hits by torpedoes and mines. Shaded places show the compartments which would be flooded should such damage occur.

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